Comparing the effect of fluoride containing remineralizing agents and Er: YAG laser on enamel Demineralization and surface microhardness around Orthodontic Brackets (An In vitro study)

Thesis

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Dedication

This work is humbly dedicated to all my valuable treasures in life:

To my wonderful mother and father who are always there for me, giving me the strength to carry on.

I don't know what I would have done without you.

To my loving husband Mohamed, for his patient, love, friendship, humor and willingness to eat out.

Love him endless thanks and gratitude.

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To my lovely sisters Amal and Amira

To my brother Mohamed my backbone and lifetime supporter

To my gorgeous nieces Hajer, Mayar, Mariam, Lamar and Celia.

To my mother, father and sister in low.

And at last but not the least to my dearest friends and colleagues.

وَمَا تَوْفِيقِي إِلَّا بِاللَّهِ

عَلَيْهِ تَوَكَّلْتُ وَإِلَيْهِ أُنِيبُ

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LIST OF ABBREVIATION

Abbreviation	Abbreviation for
WSLs	White Spot Lesions
Er: YAG	Erbium-doped Yttrium Aluminium Garnet
Er, Cr: YSGG	Erbium, Chromium: Yttrium Scandium Gallium Garnet
%	Percentage
NaF	Sodium Fluoride
fTCP	Functional Tricalcium Phosphate
HA	Hydroxyapatite
Ca	Calcium
PO_4	Phosphate
OH	Hydroxyl group
FA	Fluorapatite
CaF_2	Calcium Fluoride
CaF^+	Bound Calcium Fluoride
α-TCP $Ca_3(PO_4)_2$	Tricalcium Phosphate
CPP-ACP	Casein PhosphoPeptide- Amorphous Calcium Phosphate
ACP	Amorphous Calcium Phosphate

LIST OF ABBREVIATION (Cont.....)

Abbreviation	Abbreviation for
CO_2 laser	Carbon dioxide laser
US	United State
FDA	Food and Drug Administration
µm	Micrometer
nm	Nanometer
ERL	Er: YAG Lasers
micro-CT	micro-Computed Tomography
LICP	Laser-Induced Caries Prevention
SMH	Surface Microhardness
PLM	Polarized Light Microscope
SEM	Scanning Electron Microscopy
^oc	Celsius degree
S	Second
Mm	Millimeter
$CaCl_2$	Calcium Chloride
$NaHCO_3$	Sodium Bicarbonate

LIST OF ABBREVIATION (Cont.....)

Abbreviation	Abbreviation for
NaH_2PO_4	Sodium Phosphate monobasic
mmol/L	Millimole per liter
Hz	Hertz
mJ	Millijoule
µs	Microsecond
g	Gram
HV	Vickers Hardness
ANOVA	Analysis of Variance
SPSS- V17	Statistical Package for the Social Sciences Version 2017
SD	Standard Deviation

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Introduction

Enamel demineralization is particularly common problem during orthodontic treatment, and its treatment is one of the greatest challenges faced by clinicians. The presence of fixed appliances on tooth surfaces with brackets and bands makes it difficult to clean teeth, favor dental biofilm accumulation, in addition to increasing the prevalence of cariogenic bacteria.[1]

Clinically, the demineralization sites are detected as opaque and porous white spot lesions (WSLs) that may compromise the final result of orthodontic treatment. Enamel demineralization around orthodontic brackets may be due to acid etching during bonding of brackets, cariogenic and sticky food, accumulation of food around brackets and bad oral hygiene. [2]

WSL is considered irreversible process of the tooth surfaces loss, so prevention of demineralization is extremely important during orthodontic treatment.[3,4]

The risk of enamel demineralization can be prevented or reduced with various conventional methods including the application of remineralizing agents and different forms of fluoride treatments as well as contemporary treatments like laser irradiation. The most frequent method used in clinical practice today is the application of fluoride agents in various forms, which is a proven approach for promoting enamel remineralization.[5,6,7]

Laser technology can be used in soft tissue surgery, caries prevention, caries diagnosis, cavity preparation, and endodontic treatment for children. Caries prevention procedures have used different laser systems such as Er:

YAG (Erbium-doped yttrium aluminium garnet) and Er, Cr: YSGG (erbium, chromium: yttrium scandium gallium garnet).[8]

It was reported that caries prevention provided by the one-time initial laser treatment to be comparable to daily fluoride treatment by a fluoride dentifrice.[9]

In recent years, researchers have tended to agree that fluoride varnishes offer an effective means of not only preventing caries, but also arresting early enamel lesions.[10,11,12]

The clinical effects of fluorides depend on the chemical compounds utilized and the methods used to apply the fluoride ion to the surface of the tooth.[13]

Of the different concentrations and forms of fluoride used in varnishes, 5% of sodium fluoride (NaF) had emerged as one of the most popular form of fluoride varnish. Recently, a white 5% NaF varnish containing functional tricalcium phosphate (fTCP) has been introduced in the market (ClinproWhite varnish).[14,15]